On leave granted, the Report of the Biological Department for November was presented and ordered to be printed, with the Proceedings of last meeting.

Dec. 14th.

Vice-President BRIDGES in the Chair.

Sixty-seven members present.

The following papers were presented for publication in the Proceedings:

Ichthyological Notices, by Charles Girard, M. D.

Prodromus Descriptionis Animalium evertebratorum, quæ in Expeditione ad Oceanum Pacificum septentrionalem, a Republica federata missa, Cadwaladaro Ringgold et Johanne Rodgers ducibus observavit et descripsit W. Stimpson; pars septima, Crustacea Anomoura.

And were referred to Committees.

Mr. Wm. Parker Foulke made a statement respecting the fossil bones, shells and wood presented by him to the Academy this evening.

Passing the summer and autumn at Haddonfield, Camden County, New Jersey, Mr. Foulke learned that one of his neighbors, Mr. John E. Hopkins, while digging marl upon his farm, about twenty years ago, had found some bones. These were described as vertebræ, and as being of large size, and very numerous. Mr. Hopkins being young at the time of the discovery, and not specially interested in such subjects, had permitted visitors to carry away the fossils; so that none remained in his own possession, nor could he remember the names of any of the persons by whom the vertebræ had been taken. According to his recollection, no head had been found, nor any other bones than those of the spine, except one, which was said by him to have resembled, in general respects, a "shoulder blade." It appeared, then, not improbable that upon digging around the old pit, (which was sixteen feet long and eight feet wide,) a head, or at least a portion of one containing teeth, might be obtained. Considering the geological age of the formation upon which Haddonfield stands, and that specimens of Mosasaurus have been discovered in places not very remote from the village, there appeared sufficient motive for exploration. Mr. Hopkins, with an intelligent appreciation of the object proposed, gave to Mr. Foulke, with prompt liberality, permission to dig in any part of the farm, and to take away whatever fossils might be thus procured. There was some difficulty in ascertaining the place of the old excavation. It had been made in the bed of a narrow ravine, in which a brook flows eastwardly into the south branch of Cooper's Creek; but the pit had long since been filled to the common level of the bed, and it was in like manner overgrown with grass, shrubs, and young trees, so as to be undistinguishable by the eye. After conference with one of the diggers who had been employed at the time of the discovery, (whose indication proved to be inaccurate,) and after a careful survey of the vicinage by Mr. Hopkins, a party of experienced marl diggers were set at work; and after one day's preliminary trial, the eastern side of the old pit was detected. In conformity with Mr. Hopkins' recollection of the manner in which the vertebræ lay, the party of diggers was shifted to the western side of the old pit. The superficial deposit overlying the marl here, was only about four feet thick; the ravine being between twenty and thirty feet deep. At nearly four feet further depth, a thin stratum of decomposed shells was passed; and at about two feet below this, overlying and intermixed with another stratum of shells, the workmen came upon a pile of bones—the same now before the Academy. The total depth from the surface was between nine and ten feet.

The marl being tenacious, great care was requisite to extricate the fossils. With a small trowel and a knife, the bones were carefully dissected from their bed, and from one another. A sketch was made of their position, and some measurements were taken of them, in anticipation of the contingency of their fracture in the attempt to remove them. Several lines of transverse fracture were observable before their position was changed. Each bone was separately transferred to a board, and thus carried from the pit, and then wrapped in a piece of coarse cloth. Thus enveloped it was laid upon a thick bed of straw in the bottom of a cart; and the whole were safely transported in this way, about three quarters of a mile, to Mr. Foulke's residence. A small tooth and some fragments of a jaw were found with the other specimens.

Mr. Isaac Lea and Dr. Leidy were informed of the discovery, and they promptly visited the excavation. Their opinion of the scientific value of the fossils justified further exploration; and the diggers were kept at work, from time to time as the weather permitted, during the month of October.

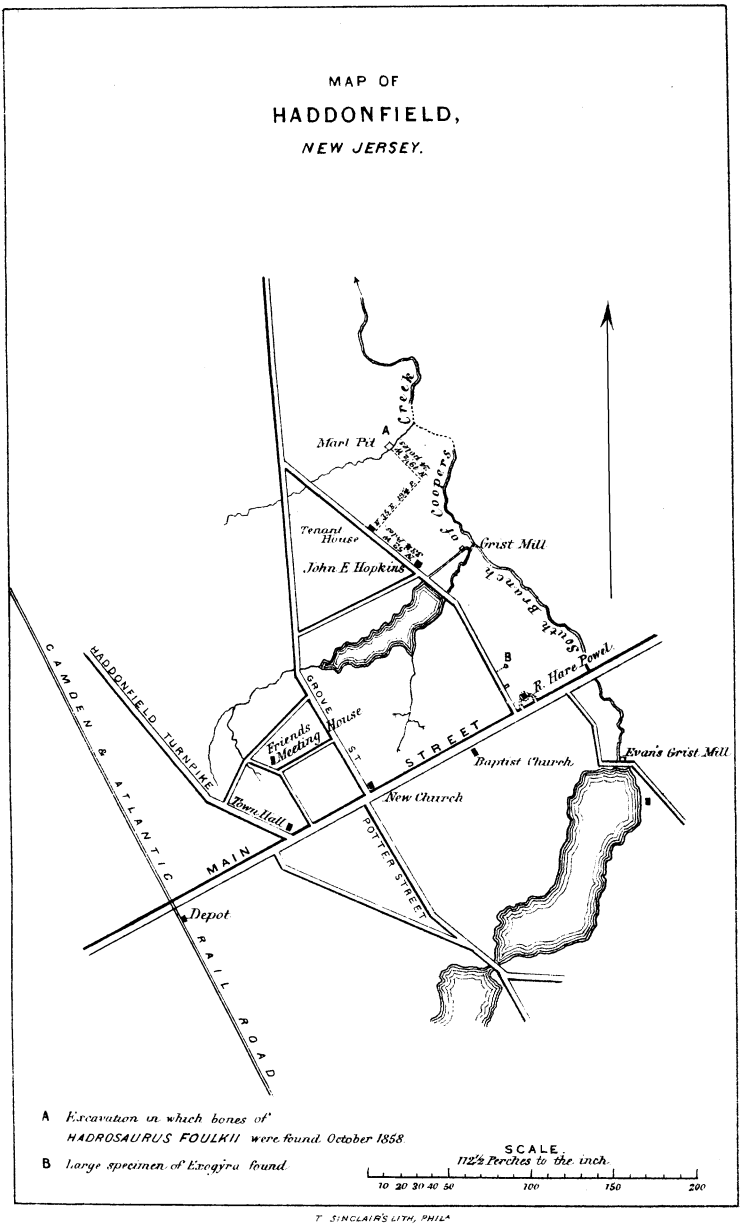
Another tooth having been accidentally turned up by Mr. Foulke near the surface of the marl which had been thrown out, the entire mass was broken up and carefully raked over; and by this process, in two or three days, the number of teeth increased to nine, and some useful fragments of jaw were also added to the collection.

Various specimens of shells were obtained; but their extreme friability rendered their preservation difficult. Several pieces of wood were found. The excavation was carried quite around the old pit, and extended so as to form a considerable area for search; but nothing further appeared, except a few vertebræ, and small fragments of other bones, and of wood, near the margin of the old pit. It seemed then useless to proceed, and the diggers were dismissed.

One of the workmen, having become interested in the search, kept his attention upon the subject; and about a week afterward found, in the green marl near the White Horse tavern (about six miles southward from Haddonfield), some vertebræ, parts of long bones, and several teeth of a crocodile, believed to be of a species not heretofore found in New Jersey; which are now in Dr. Leidy's hands for final examination. The workman stated that, at the bottom of all the diggings, casts of *cucullea* are found in great quantity. They are known at the pits by the name of "squirrel heads," from a fancied resemblance. Two specimens accompany the crocodile bones just mentioned.

Subsequently, Drs. Leidy and LeConte and Mr. Foulke made a short tour among green marl pits, worked for sale of marl, southward of Haddonfield. On the road to the White Horse, they visited the large opening of Mr. Alexander Cooper, who stated that he knew of no bones being found there—certainly none during thirty years. Near the White Horse, it was said that bones had been thrown from all the diggings. At the extensive pit of Mr. Randall Morgan, on a south branch of Timber Creek, a short distance southward from Blackwoodtown, a curious specimen of conglomerate of terebratulæ and other shells was obtained. Bones had been recently found; but they had been thrown away, and were lost. From Mr. Charles Stevenson, in the same neighborhood, it was learned that in his pit, and that of Mr. Marshall, below Mr. Morgan's, bones had been repeatedly found, but no care was taken of them. In fact, within the last year Mr. Stevenson had thrown some portions into the yard between his house and barn. After a little raking, a few crocodile bones were discovered amongst leaves and dirt. Mr. King, a blacksmith at Blackwoodtown, was said to have collected a few bones as curiosities. Upon application being made to him, he stated that he had given, or loaned, or lost, nearly all of his stock; but he produced from the corner of his workshop, three specimens which Dr. Leidy immediately recognised as fragments of jaw of Mosasaurus, each containing a large portion of a tooth; the three exhibiting very clearly the mode of dentition of the animal.

These details were presented to the notice of the members, because they suggested the probability that valuable illustrations of palæontology and geology are annually lost through the ignorance of marl diggers or the inattention of own-


MAP OF
HADDONFIELD,
NEW JERSEY.
Creek
Marl Pit
A
Tenant House
John E Hopkins
Grist Mill
South Branch
R. Hare Powel
B
HADDONFIELD TURNPIKE
GROVE ST.
Friends Meeting House
STREET
Baptist Church
Evan's Grist Mill
Town Hall
New Church
CAMDEN & ATLANTIC
MAIN
POTTER STREET
Depot
RAIL ROAD
A Excavation in which bones of HADROSAURUS FOULKII were found. October 1858.
B Large specimen of Exogyra found.
SCALE
112½ Perches to the inch.
10 20 30 40 50 100 150 200
T. SINCLAIR'S LITH. PHILA.

ers of pits. In view of the great promise of a region so near to Philadelphia, it is important that measures shall be taken to awaken in the minds of proprietors and workmen an interest in the preservation of specimens for the cabinet of the Academy.

It may be observed, upon inspection of the geological map of New Jersey, that a line drawn from the recent opening on Mr. Hopkins' farm, southwesterly in the direction of the exposure of the green sand formation, passes several miles westward of the *green* marl pits which were visited as just narrated. The marl at Mr. Hopkins' is, when in the pit, dark blue approaching black, micaceous, stiff, and tenacious. Upon free exposure to the air, it becomes, after a week or two, light bluish gray in color, and then it crumbles easily. From its not being considered as good a fertilizer as the green marl, it has been rarely dug, of late, in that part of the country; and hence there is not an opportunity for collecting fossils, such as is furnished by the pits in the green marl. The latter deposit is more seaward; and hence a diminished probability of finding in it the remains of animals which lived upon land, or in the freshwater tributaries of the old ocean.

Of the two exogyra presented on behalf of Mr. Robert Hare Powel, the smaller was dug, a number of years since, from Mr. Hopkins' farm. The larger, showing a curious peculiarity of growth, was taken more recently from a small excavation in Mr. Powel's ground, between Mr. Hopkins' and the main street. The diagram upon the table would make clear to the members the principal localities which had been mentioned.

The hard stone containing casts of shells, apparently belonging to the tertiary period, was found at about five miles south-eastward of Allowaystown; and was presented in behalf of Mr. Isaac H. Wood, of Haddonfield.

The sandstones on the table were not new nor rare; but they afford very good examples of the mode in which sand and gravel are converted into hard stone by a ferruginous cement. The specimens show interesting gradations of fineness, compactness and hardness. They came from the superficial deposit near Mr. A. Cooper's marl pit, where they lay loosely embedded. Similar stones are used in the neighborhood for coarse building purposes.

The bones found by Mr. Foulke, had been submitted by him to Dr. Leidy, for description; the shells, to Mr. Lea; and the wood to Dr. Hammond. As these gentlemen were prepared to report the results of their inspection, Mr. Foulke restricted himself to the simple introductory narrative of facts just given; reserving to a future occasion some observations which had occurred to him respecting the succession of cretaceous deposits in New Jersey, and the relations of and and sea during the cretaceous period.

Dr. Leidy stated that the bones, mentioned in the remarks of Mr. Foulke, obtained from the marl of Mr. Hopkins' farm, near Haddonfield, New Jersey, and now exposed to the view of the Society, were those of a huge herbivorous saurian. The animal was closely allied to the great extinct *Iguanodon* of the Wealden and Lower Greensand deposits of Europe; the genus is, however, different, and for it the name of HADROSAURUS is proposed.

Besides a number of small fragments, the bones consist of twenty-eight vertebræ, mostly with their processes broken away; a humerus, a radius and an ulna, complete; an ilium and a pubic bone, imperfect; a femur, a tibia and a fibula; two metatarsal bones and a first phalanx, complete. There are also in the collection nine teeth and a small fragment of the lower jaw.

The bones are ebony black, from the infiltration of iron, and are exceedingly heavy. Their texture is firm and well preserved; and they are neither crushed nor water rolled. In association with them, besides the shells and wood, were found several teeth of *Odontaspis* and *Enchodus*.

Most of the specimens of teeth of the *Hadrosaurus* appear to have belonged to the lower jaw. These, when unworn and perfect, are about two inches long, and of all known teeth most resemble those of the *Iguanodon*. They have a demi-conoidal crown, with a lozenge-shaped enamel surface directed inwardly, and divided by a prominent median carina. The upper borders of this surface

are provided with short, transverse, tuberculated ridges. The body of the crown outwardly is paraboloid in transverse section, and is prolonged into a laterally compressed conoidal fang. As the teeth were worn away from the summit, their gradually expanding triturating surface sloped downward and outward. This surface is shield-like in outline, is bordered by enamel internally, and crossed by a slightly elevated crucial ridge with diverging branchlets. The ridge, resulting from the later ossification of the dental pulp, is harder than the surrounding dentine, and is adapted to retain a rough triturating surface. The sides and bottoms of the teeth exhibit the impressions of lateral and inferior successors, and appear to indicate that the teeth in use, together with those more or less developed within the jaw, had a quincuncial arrangement.

Two of the specimens of teeth perhaps belong to the upper jaw. They differ from the others in the extraordinary degree of development of the median carina of the crown. The enamelled surface was perhaps directed in a reverse manner to that of the lower teeth; that is to say, outwardly. It is likewise lozenge-like in outline, and tuberculated at the lower borders. The body of the crown inwardly is half oval in section. The fang for more than half its width is prolonged from the carina of the crown. These teeth also exhibit the impress of successors holding the same relative position with one another as in the lower teeth.

The fragment of the lower jaw is a portion of the left dentary bone, and is three inches in depth. It has an outer parapet wall about two inches high, with deep vertical grooves for the support of the teeth. No corresponding wall appears to have existed on the inner side of the latter.

The cervical vertebræ have their bodies prominently convex in front and deeply concave behind, and would appear to indicate that Mantell was correct in assigning similar vertebræ, found in the Wealden deposits of England, to the *Iguanodon*. Three cervical vertebræ, suspected to be the third, fourth, and fifth, are two and a half inches long at the sides.

Five succeeding vertebræ, not immediately conjoining the ones just mentioned, and supposed to be anterior dorsals, likewise have convexo-concave bodies. At the sides of the latter they are from 3 to 3½ inches long, and posteriorly are 3½ inches wide. The sides of their arch present a deep pit for the articulation of a rib; but no articular mark is perceptible at the sides of the bodies. Two other vertebræ, perhaps posterior dorsals, have the bodies slightly prominent in front and slightly concave behind; and they are 3½ inches long at the sides, and 4¾ inches wide posteriorly.

The caudal vertebræ possess articular surfaces for chevron bones; and the specimens we possess, from different parts of the tail, give the following succession of measurements of their bodies: length 2½ inches, breadth 5 inches; length 3 inches, breadth 4½ inches; length 3 inches, breadth 3½ inches; length 2¾ inches, breadth 2½ inches; length 2½ inches, breadth 1¾ inches. From the gradation of size of seventeen specimens in the collection, it may be estimated that there were originally about fifty vertebræ to the tail. This number may be too great by about ten, but certainly not more.

A caudal vertebra from near the middle of the tail has its arch and spinous process complete. The two latter together measure 11 inches long from the body, which is 4½ inches deep. The addition of a chevron bone would indicate the tail of the animal, at its middle, to have been between one and a half and two feet in depth.

The *humerus* is perfect, and is 23 inches long. Its breadth at the tuberosities, between which the head projects midway, is 7 inches. The shaft above is compressed from without inwardly; its lower part is cylindroid, and near the middle of the bone measures 9¾ inches in circumference. At the condyles the transverse diameter is 5½ inches. Only a very short and narrow medullary cavity occupies the centre of the shaft.

Both bones of the forearm are solid. The *ulna* is 23 inches long, and 7

inches in circumference at the middle. The *radius* is 20 inches long, and 6 inches in circumference at the middle.

A very great disproportion exists between the bones of the fore and hinder extremities. So much is this the case, that I was at first inclined to believe they belonged to different animals. The disproportion is even greater than in the *Iguanodon*, as indicated by comparison with the remains of an individual of the latter, in the British Museum, known as the Maidstone specimen.

The *ilium* has its two extremities broken away, and in its present condition is 27 inches long. Its sacral articular surface is 12 inches long by 3 inches thick. The breadth of the bone, opposite the latter surface, is from 7 to 9 inches. A bone, which I suspect to be the *pubic*, but which appears to correspond with that, of the Maidstone *Iguanodon*, described as the clavicle, is 26 inches long in its present state; one end being broken away. The remaining pubic extremity is $10\frac{1}{2}$ inches wide.

The *thigh bone* is 40 inches long; its breadth at the head and adjoining trochanter is 9 inches; its breadth at the condyles is 8 inches; and the antero-posterior diameter of the internal condyle is 10 inches. The shaft is quadrate, and provided at its middle portion internally with a large trochanter. The circumference of the shaft just above the latter is 17 inches; just below it, 15 inches. The condyles in front enclose a large foramen terminating a groove descending from the shaft. Posteriorly, at the bottom of the intervening notch, they enclose a smaller foramen. The medullary cavity is of large size, and extends about half the length of the shaft through its middle portion.

The *tibia* is $36\frac{1}{2}$ inches long; its breadth at the upper part is 11 inches; and its breadth below is 10 inches. Its shaft is narrow and cylindroid at the middle, where it measures $11\frac{3}{4}$ inches in circumference. From this position it rapidly expands towards the two extremities of the bone. The medullary cavity is very short and narrow.

The two *metatarsal bones* are of robust proportions and are each about 11 inches long. The *proximal phalanx* of a toe is 6 inches long, and $5\frac{1}{4}$ inches broad at base.

If we estimate the number of vertebræ of the trunk of *Hadrosaurus* to have been the same as in the recent Crocodile and Iguana; the number of sacral vertebræ to have been the same as in the *Iguanodon;* and the number of caudal vertebræ to have been fifty; the whole number of vertebræ would have been eighty. A calculation of the length of the specimens of vertebræ in our possession, with a proper allowance of separation by intervertebral fibro-cartilages, and an addition of two and a half feet as an estimate of the length of the head, would give, as the total length of the animal, about twenty-five feet.

The great disproportion of size between the fore and back parts of the skeleton of *Hadrosaurus*, leads me to suspect that this great extinct herbivorous lizard may have been in the habit of browsing, sustaining itself, kangaroo-like, in an erect position on its back extremities and tail. As we, however, frequently observe a great disproportion between the corresponding parts of the body of recent and well known extinct saurians, without any tendency to assume such a position as that mentioned, it is not improbable that *Hadrosaurus* retained the ordinary prostrate condition, progressing in the manner which has been suspected to have been the case in the extinct batrachian of an earlier period, the *Labyrinthodon*.

Hadrosaurus was most probably amphibious; and though its remains were obtained from a marine deposit, the rarity of them in the latter leads us to suppose that those in our possession had been carried down the current of a river, upon whose banks the animal lived.

Occasionally uncharacteristic fragments of huge bones have been found in the green sand of New Jersey, (of which we have several in the collection of the Academy,) which I suspect to belong to *Hadrosaurus*. One of these specimens, exposed to the view of the members, indicates a much larger individual than the one whose remains have been presented this evening.

The species I would respectfully propose to dedicate to our fellow member W. Parker Foulke, than whom none of our number is more zealous in the advancement of the great objects of this Academy. The name of the great extinct saurian will then appear as HADROSAURUS FOULKII.

Mr. LEA remarked that the members must all feel under great obligations to their fellow member, W. Parker Foulke, Esq., for the conception, the industry and perseverance which he has brought to the exhumation of these various reliques of a former state of existence of organisms, totally different from any which now live on the surface of the earth; for there no longer now remains a single creation which had life during the whole of the Cretaceous period. With the true spirit of scientific investigation he has enabled geologists to examine these important remains of a former world, and with equal liberality he has placed the whole in the possession of the Academy. It was with very great pleasure that Mr. Lea assisted, with Dr. Leidy for a few days, by the invitation of their friend, during the progress of his successful labors.

The result has been that one of the most interesting fossil animals on record has been added to the fauna of this period, the bones of which have just been so happily illustrated by Dr. Leidy. There were also numerous genera and species of *Mollusca*, as well as coniferous plants added to our palæontology and fossil botany.

Geological science is indebted to our late fellow member, Prof. Vanuxem, for the identification of the marl beds of New Jersey and Delaware with the Cretaceous group of Europe, but it was not then known in either country that there were so many subdivisions of the group, and the exact parallelism of the green sand was not attempted to be traced. While studying in Paris, under the instruction of Brogniart, he was led to the conclusion, from his previous examination of many of these "marl pits," with Mr. Lea, that the *mollusca* were the same which belonged to the upper beds of Brogniart's "Pelagiques." At that early period of our geological history, when he was examining the Paris basin, he was convinced, in 1818, that the alluvial of Maclure consisted of "secondary, tertiary, and alluvial masses." Subsequently, in January, 1828, his notes were published in the Journal of this Academy,* and he gave a tabular view of the "relative geological position" of the secondary, tertiary, and alluvial formations of the United States. He also defined their "geographical position," and stated that "this bed, (green sand), was argillaceous, and contained greenish particles analogous to those which are found in the green sand, or chalk, of Europe," and that it was "characterised by six genera, viz., *Terebratula*, *Gryphæa*, *Exogyra*, *Ammonites*, *Baculites* and *Belemnites*." These views of Professor Vanuxem were subsequently confirmed in various papers, also published in the Academy's Journal, by Dr. Morton, who, in his "Synopsis of Organic Remains," published in 1834, page 7, says that "Mr. Vanuxem was the first to detect the analogy between this deposit (Ferruginous sand,) and the chalk formation of Europe." Other geologists in various papers and state reports have, by their developments, confirmed the opinions of Prof. Vanuxem, and from year to year new explorations have tended to demonstrate the vast extent of the Cretaceous Formation in the United States east of the Rocky Mountains.

The Cretaceous Formation commences at Martha's Vineyard, in Massachusetts, is largely developed in New Jersey, and is found in Delaware, Maryland, Virginia and the Carolinas. In Georgia, it is more largely developed. Here, sweeping round the inferior strata, the Primary, Silurian, and Carboniferous masses, it continues in a very enlarged band in a northerly direction, through Alabama, Mississippi and Tennessee, to near the mouth of the Ohio River. Crossing the Mississippi River, it descends to the south-west, through Arkansas, where on the upper waters of the Red River it expands to the north, through Nebraska Territory, far into the British Possessions east of the Rocky Moun-

* Vol. 6, page 57.

tains, embracing the head waters of the River Saskatchewan.* To the west, from Red River, it extends to and beyond Santa Fe, embracing the head waters of the Colorado, and stretching north-west, reaches the head waters of the Columbia, as well as those of the Missouri River. Following a south-western direction from Red River through Texas, it crosses the Rio Grande into New Leon, and thence south through St. Luis Potosi, it passes indefinitely into Mexico.

In all the great extent of this formation, there is evidence of the *cretaceous period*, while most of the species differ from our eastern fauna, as the lithological characters do in the rocks and sediments.

In New Jersey, the green sand beds are but slightly calcareous, the limestone lying above having about 80 per cent. of lime. In North and South Carolina, it is, according to Pro. Tuomey, "25 to 30 per cent. of the mass," but in Alabama it is "highly calcareous."

This vast extent of a simultaneous deposit of this kind, is calculated to excite the greatest interest, when we consider how much it affects our agricultural prosperity; and in a geological point of view, it has received the attention of many of our ablest investigators.

Prof. Vanuxem, in the first place, had in view, the division of McClure's "alluvial," and in his paper he gives a table, dividing it into secondary, tertiary, and alluvial. To these he gave seven subdivisions—two only to the secondary, No. 1, being "Marl of New Jersey and Delaware," which he refers to the "green sand, or chalk of Europe."

Dr. Morton, in his "Synopsis of Organic Remains," (page 13,) in 1834, six years subsequently, gives in a table the same three grand divisions, with a difference in the subdivisions, assigning the name of "Ferruginous sand" to the lower division in which Prof. Vanuxem had continued the name of "Marl of New Jersey," the equivalent of "green sand, or chalk of Europe." Subsequently, in June, 1835, in an appendix, page 89, he separates the "Cretaceous deposits of America" into three divisions, the "Upper, Medial, and Lower."

In 1840, Prof. H. D. Rogers published his Report on the Geology of New Jersey, in which he separated the cretaceous group into five divisions, under the name of "the upper secondary series, embracing the green sand formation."

1. A group of sands and clays, extremely white and pure.
2. A mixed group, consisting of *green sand*, alternating with and occasionally replaced by layers of a blue, sandy, micaceous clay, the so-called "green sand formation."
3. A yellowish, granular limestone, having a profusion of organic remains.
4. A yellow, very ferruginous coarse sand, with some fossil shells of the green sand formation.
5. A coarse, brown, ferruginous sandstone, sometimes passing into a conglomerate.

Subsequently, in Johnston's Physical Atlas, 1855, under the name of "Newer Mesozoic," he continues these divisions, the whole thickness of which he presumes to be a thousand feet.

Prof. Tuomey, in the tables of his geological survey of South Carolina, in 1848, calls the New Jersey deposits "upper green sand;" those of South Carolina, "the gault;" those of Alabama, the lower green sand, equivalent to the Néocomien of the French geologists.

In 1854, Messrs. Hall and Meek made a communication to the American Academy of Arts and Sciences, on some fossils from the Cretaceous Formation of Nebraska. This they divide into five sections.

5. Arenaceous clay passing into argillo-calcareous sandstone.
4. Plastic clay, the principal fossiliferous bed of the upper Missouri.
3. Calcareous marl, containing *Ostrea congesta*, &c.
2. Clay containing few fossils.
1. Sandstone and clay.

* See the map of Nebraska, by Lieut. Warren and Dr. Hayden, with explanations by the latter who has done so much for the geology of the Western Territories; also the excellent map of Hall & Lesley, in Major Emory's Report on the Mexican Boundary Survey, and Prof. Hall's Report of the Geology of the Boundary in the same volume. Also, the various papers of Meek & Hayden.

In 1855, Mr. Marcou published, in the Bulletin of the Geological Society of France, an account of the Geology of the United States, in the cretaceous division of which, (page 70,) after giving to Prof. Vanuxem the credit of being the first to detect this group in the United States, he says that it may be divided provisionally into "three great groups," which have been named in Europe, 1st, le Néocomien; 2d. le grès vert supérieur et la craie marneuse; 3d, la craie blanche.

In March, 1856, Mr. Meek and Dr. Hayden, published their section of the Cretaceous formation of Nebraska, in the Proceedings of the Academy of Natural Sciences, which they republished more fully in the following November, also in the Academy's Proceedings.

5. Gray and yellowish arenaceous clays, with great numbers of marine mollusca, few land plants and bones of Mosasaurus.

4. Bluish and dark plastic clay, containing numerous marine Mollusca.

3. Lead gray calcareous marl, with scales of fishes. *Ostrea congesta, Inoceramus*, &c.

2. Dark gray laminated clay, with scales of fishes, small ammonites, &c.

1. Heavy bedded yellowish sandstone, with water-worn lignite. This formation they say may not belong to the cretaceous system.

Prof. Hall in his Geological Report, August, 1856, connected with Major Emory's Mexican Boundary Survey, gives an excellent table prepared by Prof. G. H. Cooke, of the New Jersey Survey, which divides the whole of this system in New Jersey into eight members, which may be thus succinctly given:—

8. Green Sand, 3d or upper bed.
7. Quartzose Sand.
Nos. 4 and 5 Nebraska section.
6. Green Sand, 2d bed—(a) *Eschara*, &c.
(b) *Gryphæa*, &c.
(c) *Cucullea*, &c.
5. Quartzose sand, highly ferruginous—*Exogyra*, &c.
4. Green Sand, 1st or lower bed—*Exogyra, Ostrea*, &c.
3. Dark colored clay, containing green sand—*Ammonites Delawarensis*, &c.
2. Dark colored clay—Fossil wood, no animal remains.
1. Fire Clay and Potter's Clay—Fossil wood and leaves, no animal remains.

In May 1857, Mr. Meek and Dr. Hayden, in the Proceedings of the Academy, continued their valuable papers on the Tertiary and Cretaceous formation of Nebraska, and gave a table of equivalents with the New Jersey deposits, and Dr. Hayden in June of the same year made a communication entitled "Explanations of a second edition of a geological map of Nebraska and Kansas," in which the whole series of formations is reviewed, including the cretaceous system.

It is a very important matter in discussing these organic remains to ascertain, as nearly as possible, the horizon on which this particular formation would stand in regard to its parallelism with those of Europe, where so much has been written on the subject of the various members of the Cretaceous group.

Sir Charles Lyell says, that the New Jersey "strata consist chiefly of green sand and green marl, with an overlying coraline limestone of a pale yellow color, and the fossils, on the whole, agree most nearly with those of the upper European series from the Maestricht beds to the gault inclusive." *

Professor Rogers in his New Jersey Report, does not seem to agree with this idea; he "does not regard these strata as the equivalents in the strict sense of the word, of the green sand formation, so called, of Europe" (page 178). "Nor are we able," he says, "positively to decide, merely by the relationship of the genera, whether the cretaceous period embraces both the commencement and termination of the American green sand series" (page 179).

M. D'Orbigny † considers the chalk formation of North America to belong to

* Manual, third edition, page 224.

† Cours Elémentaire, page 671.

his "étage sênonien" (the upper chalk of Morris) and not to the "grès verts," as supposed by Dr. Morton and others.

Dr. Mantell considered that the teeth of the *Mosasaurus*, found in the green sand formation of New Jersey, described by Dr. Harlan, were in every respect analogous to those of the Maestricht reptile, and that the deposit was equivalent to the Maestricht bed.

The Blackdown green sand of Dr. Fitton‡ has in its fossil *mollusca* a very strong resemblance to our green sand fossils, and as D'Orbigny makes this formation an equivalent to his Cênomanien, there is some evidence that the New Jersey green sand may be on the same horrizon; for according to D'Orbigny's tables the genus *Belemnites* ceases with the Cénomanien, and we have abundance of that genus in our green sand formation. If he be correct as to the decadence of the Cephalopoda, then we could not place this formation higher up in the series than his Cénomanien, which is the "Glauconie crayeuse" of Brogniart, found at Cap le Hêve in France, the Blackdown green sand of Fitton and the Upper green sand of Mantell in the south of England.

Under all the information, we have, however, from the various investigations made by so many distinguished geologists, I think the evidence is in favor of D'Orbigny's opinion, that the green sand formation, from which these fossil remains were exhumed, belong to his Sênonien, but it may prove upon further examination to be a little lower in the Cretaceous series.

That portion of the grey micaceous clay at Haddonfield, in which the *Mollusca*, all marine, were generally found, was some ten feet from the surface of the soil. The declination of the layer is very gentle and towards the south east. The bones and coniferous wood were so near or interspersed with the shells as to tend to prove that they must have lived in the vicinity of the shores which the *Mollusca* inhabited, for these show that they were deposited in a sediment totally and completely at rest. The most tender and delicate forms remain without abrasion, and usually, in the case of the bivalves, the two valves are attached. The great tenacity, however, of the clay, and the extreme tenderness of the shells, render it almost impossible to get out perfect specimens, and when they come under the action of the atmosphere, and become desiccated, the calcareous matter crumbles to pieces, the base membrane composing the animal portion of the shell having been previously entirely absorbed.

I propose here to give a hasty list of the genera which were collected, reserving for a future time, when more at leisure, the specific differences of those which are new. It will be observed that the *Lamellibranchia* greatly prevail over the *Gasteropoda*.

List of Genera:—Pinna, 1 species; Inoceramus, 2 do.; Ostrea, 3 do.; Anomia, 1 do.; Corbula, 2 do.; Arca, 1 do.; Cardita, 1 do.; Exogyra, 1 do.; Siliquaria, 2 do.; Nucula, 3 do.; Trigonia, 1 do.; Tellina, 2 do.; Pecten, 2 do.; Turritella, 1 do.; Dentalium, 1 do.; Natica, 1 do.; Buccinum, 1 do., Pterocera, (?) 1 do.; Ammonites, 2 do.; Scaphites, (?) 1 do.; Echinus, 1 do., (spines of); Eschara, 1 do.; 1 Coprolite; 2 small vertebræ of fishes.

Dr. Hammond observed in relation to the fragments of fossil wood found in the same locality as the bones and shells described this evening by Dr. Leidy and Mr. Lea, that he had submitted them to a careful examination, the details of which might prove of interest to the Academy.

Upon inspecting the pieces of this wood placed upon the table, it will be perceived that they are all of an intensely black color, but differ greatly in degree of hardness. One specimen is so soft as to crumble readily on the slightest handling; whilst another is dense and hard, and capable of receiving a high polish. Several of the fragments exhibit teredo perforations, a circumstance of considerable interest. These perforations are so completely filled with sulphuret of iron that casts of them are readily obtained. All the fragments are more or less im-

‡ Strata below the Chalk.

pregnated with this mineral. In some parts the organic tissue has been entirely removed, and nodules of the sulphuret have taken its place; in others the mineral has entered the cells and tubes of the wood, leaving these of their natural forms. Occasionally perfect casts of the cells are found detached from the tissue when the specimen is mounted in Canada balsam.

It was of course highly desirable that these woods should be submitted to microscopical examination. He found, however, upon trial that it was impossible to cut satisfactory sections without removing the sulphuret of iron. This was done by macerating pieces of the wood in dilute chlorhydric acid. After this process they were readily cut into sections with a suitable knife, or ground down till the requisite degree of tenuity was obtained.

Sections thus obtained when placed under the microscope showed conclusively that the wood was of the coniferous family of plants. For some time Dr. H. was under the impression that one fragment belonged to an entirely different class. This idea arose from the fact that from an examination of eight or ten vertical sections none of the characteristic pits or cells could be perceived, nor any indication of the existence of medullary rays. Finally, however, he obtained a section which exhibited both very clearly, and a transverse section which previously he was unable to cut, positively determined it to be of the same character as the other pieces.

Some cause or other, probably the carbonizing process, had entirely destroyed the pits which had existed; a fact of some importance in investigations of this nature. All the fragments appear to belong to the same species of conifer, and as far as Dr. H. could judge do not differ essentially in microscopic characters from the pines which now grow on the locality.

Mr. T. Edwards Clark had kindly given him some specimens of a fossil wood described by Unger, which in many respects resembles that referred to, the pits being absent from a large portion of the tissue.

On leave granted, the thanks of the Academy were tendered to his Excellency, Wm. F. Packer, Governor of the State, for the donation of a White Deer, presented this evening.

Dec. 21*st.*

Vice-President BRIDGES in the Chair.

Forty-one members present.

Papers were presented for publication in the Proceedings, entitled:

Description of new genera and species of N. American Lizards, in the Museum of the Smithsonian Institution, by Spencer F. Baird.

Remarks on the lower Cretaceous beds of Kansas and Nebraska, with descriptions of some new species of Carboniferous fossils from the valley of the Kansas River, by F. B. Meek and F. V. Hayden.

And were referred to Committees.

Dec. 28*th.*

Vice-President BRIDGES in the Chair.

Sixty-five members present.

The Report of the Biological Department for December was presented.

On report of the respective Committees, the following papers were ordered to be printed in the Proceedings: